Fourier-Bessel based Rapid Earthquake Magnitude Estimation in Central Oklahoma

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In order to assess earthquake hazard and prepare mitigation before destructive events occur, accurate rapid estimation of event magnitude is of great importance. We investigate the application of a Fourier-Bessel transform based algorithm for local magnitude estimation using an earthquake sequence well recorded by local earthquake network in central Oklahoma. A relation between the first few hundred milliseconds of the first-arriving energy at the surface, the P wave, and the local magnitude of the earthquake has been developed. The method is based on seismic waveform analysis. The distance between earthquakes and stations is compensated, and instrument responses are also removed before magnitude calculation. The proposed method is based on a signal decomposition approach, so the results are expected to be less scattering than other relevant recursion based magnitude estimation methods, such as the predominant period estimator (PDE) approach. The Fourier Bessel (FB) coefficient has a nonlinear relationship with the frequency responses, so an adaptive FB range selection will be developed for the magnitude estimation. From the preliminary results, the maximum amplitude inverted from FB coefficients for a trail time window and frequency range seems to correlate satisfactorily with the earthquake magnitude. This observation inspires us to build an empirical relation which associates the FB coefficients with the local reported magnitude. The proposed method can provide a quick estimation of the earthquake's magnitude. The future work will focus on its accuracy improvement. In addition, this method can also be combined with an automatic arrival picker to develop a workflow for automatic picking and magnitude estimation.